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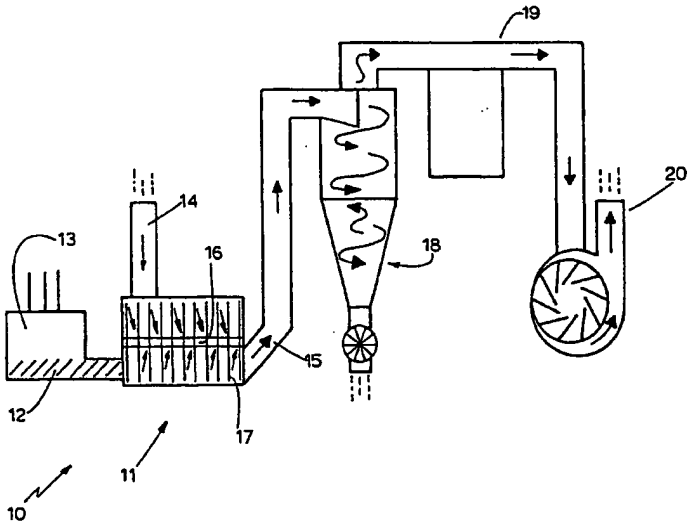

(57) Abstract

Referring to the figure there is illustrated a low temperature dryer (10) where the central element of the dryer is a cold aerosolizer (11) having an infeed auger (12) from an infeed bin (13) and an air inlet (14) and a product, aerosol and air outlet duct (15). The core aerosolizer comprises a central shaft (16) and a plurality of blades (17). The outlet duct then carries the partially dried material, the aerosol and the air into a cyclone (18) where the plant material is extracted while the air and the aerosols flow to a condenser (19) where the liquids are removed. The dry air is discharged at an outlet (20) of the system. The expression "low temperature" referred to herein means a temperature, normally ambient, but can be above ambient, such as to minimise heat degradation of nutritional factors in the product or products being processed.

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LOW TEMPERATURE FLOW DRYER AND PROCESS

FIELD OF THE INVENTION

THIS INVENTION relates to a process and apparatus for drying and in particular but not limited to a process and apparatus for drying plant material such as grasses and leaves including tea.

BACKGROUND ART

The present drying processes involve the use of a decanter to remove unbound moisture prior to application of heat. Decanters are expensive.

Present drying processes employing artificial heat while effective in drying tend to reduce substantially the nutritional value of the dried product.

OUTLINE OF THE INVENTION

It is therefore an object of the present invention to provide a process and apparatus which enables unbound moisture to be extracted in a low temperature environment which is less expensive than prior art methods providing a substantial reduction in moisture content while maintaining to a greater degree the nutritional value of the product produced.

It is a further object of the present invention to provide free moisture and oil aerosols within the process air stream as a result of the process.

It is a further object of the present invention to enable the capture of free moisture and oil aerosols from the process air stream.

It is a further object of the present invention to provide product of a pre-determined particle size.

It is a still further object of the present invention to provide a product having a pre-determined moisture content.

It is a further object of the present invention to provide a process whereby there is a higher retention of essential oils and colour.

In one aspect therefore the present invention resides in a process for the removal of moisture and oils from plant material by physical agitation in a low temperature, preferably ambient air stream comprising the steps of:

(i) causing relatively moist plant material to flow across a high velocity air stream while being maintained as a rotating band within the air stream;

(ii) retaining the plant material in the said band to comminute the plant material and to cause physical separation of liquids from the plant material as an aerosol;

(iii) progressively removing air, the aerosol and relatively dry comminuted material entrained in the air from the band of plant material;

(iv) separating the air stream and aerosols from the comminuted plant material entrained therein;

(v) and collecting the relatively dry comminuted material.

In another aspect the invention resides in an apparatus for low temperature drying of plant material, the apparatus comprising a flow dryer having an inlet duct in series with aerosolizer followed by an outlet duct, the said aerosolizer having a chamber including an aerosolizer inlet communicating with the inlet duct and an aerosolizer outlet communicating with the outlet duct in order for a stream of low temperature gas to flow through the aerosolizer chamber, a plurality of aerosolizing blades mounted for rotation in the aerosolizer chamber so that particles of matter circulate in the aerosolizer chamber as a band by reason of the rotation of the blades, the rotation of the blades and the high velocity air stream through the chamber causing separation of unbound liquids as an aerosol entrained in the air stream which leaves the chamber through the outlet.

The expression "low temperature" referred to herein means a temperature, normally ambient, but can be above ambient, such as to minimise heat degradation of nutritional factors in the product or products being processed.

The present invention embodies a process whereby the primary mechanism for separation of liquids from the plant material is a physical process rather than a thermodynamic process. Initially the plant material in the aerosolizer is broken up by the rotating blades and the smaller particles are maintained in a band under the influence of a high velocity air stream ranging in velocity from 5 metres per second to 25 metres per second. This causes a capillary type action to extract further unbound moisture from the plant material. As the size of the plant material is further reduced there is some cellular structural breakdown in the plant material releasing further liquids into the high velocity air stream.

As a consequence of the rotation of the blades and the high velocity air stream, liquid including water and oils are released from the plant material, this liquid is caused to form droplets within the air stream and is then carried out of the aerosolizer where it can be processed through a condenser to obtain a liquid from which the oils can be extracted. Due to the low temperature the oils are maintained in their most nutritious state.

In a preferred form the aerosolizer is utilised as part of a pre-dryer assembly whereby after exiting the aerosolizer the partially dried comminuted material is then fed into a thermodynamic flow dryer where it is further dried under evaporative drying.

The aerosolizer preferably comprises a cylindrical chamber having a peripheral wall, a central shaft carrying longitudinally spaced radially extending blades, the blades extending to the peripheral wall of the chamber and the speed of rotation of the blades and their spacing being selected to form incoming material into an annular fluidised bed adjacent the peripheral wall, the aerosolizer having an air inlet and an air outlet for moving material in a downstream direction and a fluidised bed interrupter between the inlet and the outlet interrupting flow of the fluidised bed to increase the residence time of material in the aerosolizer chamber. Preferably the interrupter is adjustable to enable residence time to be varied.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the present invention can be more readily understood and be put into practical effect reference will now be made to the accompanying drawings which illustrate preferred embodiments of the invention and wherein:-

Figure 1A illustrates a low temperature dryer according to a preferred embodiment of the present invention;

Figure 1B is a section through a typical aerosolizing chamber; and

Figure 2 illustrates a two stage drying process whereby material is pre-dried in an aerosolizer and then processed through an evaporative dryer.

Figures 3 and 4 are longitudinal section and cross-section through a typical aerosolizer.

METHOD OF PERFORMANCE

Referring to the drawings and initially to Figure 1A there is illustrated a low temperature dryer 10 where the central element of the dryer is a cold aerosolizer 11 having an infeed auger 12 from an infeed bin 13 and an air inlet 14 and a product, aerosol and air outlet duct 15. The cold aerosolizer comprises a central shaft 16 and a plurality of blades 17. This is illustrated in section in Figure 1B. The outlet duct then carries the partially dried material, the aerosol and air into a cyclone where the plant material is extracted, that is cyclone 18, while the air and the aerosols flow to a condenser 19 where the liquids are removed. The dry air is discharged at 20.

The process operates usually at ambient conditions but does not exclude the application of a small amount of heat to raise the air temperature to say 20°C where desirable.

Referring to Figure 1B the aerosolizer chamber 11 is illustrated showing blades 17 and the outlet from the chamber at 21. The outlet from the chamber includes an opening that has a sliding closure member 22 so that the size and position of the opening can be varied to adjust the size of the material removed.

Referring now to Figure 2 there is illustrated another form of the invention. In this case the system comprises a co-dependent two stage process. The first process is aerosolizing and moisture reduction involving items 31 to 40 inclusive. The second process is final drying involving items 41 to 50 inclusive. The main principles of the system are as follows.

A vacuum is produced by a fan 31 which is used for both the transport of air and for the mechanical movement of the product through the aerosolizing system.

The process air enters the system tangentially through a duct 32 into the cold aerosolizing cylinder 34.

The product enters the system through an infeed buffer bin/feed auger 33 feeding axially to a cold aerosolizing assembly 34 and 35.

The cold aerosolizing chamber 34 is comprised of a horizontal cylinder with either a series of rotating aerosolizing blades or a rotating squirrel cage assembly 35. The objective of the cold aerosolizing chamber assembly 34 and

35 is the comminution of the product as well as the creation of a fluidised bed of product and air around the internal periphery of the cold aerosolizing cylinder 34. The selection of aerosolizing blade assembly or squirrel cage assembly is dependent upon the exact product to be processed as well as the desired specification of the product required post processing.

The air/product mixture exits the cold aerosolizing chamber assembly 34 and 35 through an adjustable aperture 36. The adjustable aperture facilitates the control of the product retention time within the cold aerosolizing chamber assembly 34 and 35.

The air/product mixture travels via a tower duct 37 to the cyclone 38. The cyclone 38 is responsible for the separation of the product and the process air. The product exits the aerosolizing system through the rotary valve 39 placed at the bottom of the cyclone 38 and is conveyed by a chute or auger 41 to the drying tower 42 and the process air exits the cyclone 38.

The air travels to the condenser 40 where any water or oil aerosols are extracted before continuing on to the fan 31. The velocity and quantity of air is determined by a discharge louvre on the exit duct of the fan 31. Beyond the fan 31 the air is to be ducted either to the atmosphere or to a secondary air treatment plant in accordance with prevailing local requirements.

A vacuum is produced by a fan 48 which is used for both the transport of air and for the mechanical movement of the product through the drying system.

Hot air generated by the burner at the end of the burner chamber/manifold duct 45 passes through the perforated plate 44 and the slow rotating disc agitator 43.

The product is deposited by the chute/auger 41 onto the slow rotating disc agitator 43 and perforated plate 44 located within the drying tower 42 and aligned at an angle to the drying tower 42. The slow rotating disc agitator 43 consists of a spoke wheel type arrangement positioned directly above and close to the perforated plate 44. The purpose of this assembly is to maintain the product within the air stream and not allow it to settle at the bottom of the drying tower 42.

The design of the drying tower 42 is such that retention of the product is required for a few seconds before the mass of the product can attain the terminal velocity of the air passing through the system.

The product can only be evacuated out of the drying tower 42 once the evaporation is sufficient for it to attain a speed close to terminal velocity.

The product/air stream flows from the drying tower 42 directly into the cyclone 46. The cyclone 46 is responsible for the separation of the product and the process air. The product exits the drying system through the rotary valve 47 placed at the bottom of the cyclone 46.

The air travels on to the fan 48. The velocity and quantity of air is determined by a discharge louvre on the exit duct of the fan 31. Beyond the fan 48 the air is to be ducted either to the atmosphere or to a secondary air treatment plant in accordance with prevailing local requirements.

Oversize particles whose size/mass exceed the transport capacity of the air stream within the drying tower 42 will exit the drying tower 42 through a sealed side opening and exit through the rotary valve 49. An auger 50 will transport the oversize particles back to the infeed buffer bin/feed auger 33 to be passed through the entire process again.

Referring to Figures 3 and 4 a preferred aerosolizer 51 is illustrated. The aerosolizer 51 includes a cylindrical chamber 52 having a shaft 53, and inlet 54 and outlet 55. An adjustable fluidised bed interrupter plate 56 is adapted to slide into the chamber to interrupt the flow of the annular fluidised bed 56 formed by rotating of the blades 57. In the illustrated embodiment the interrupter plate forms a chord blocking the fluidised bed and causing it to distort and flow down around the plate thus causing the particles in the bed to remain longer in the aerosolizer than would otherwise be the case, adjusting the depth of the plate enables the residence time to be varied.

Whilst the above has been given by way of illustrative example of the present invention many variations and modifications thereto will be apparent to those skilled in the art without departing from the broad ambit and scope of the invention as herein set forth in the appended claims.

CLAIMS

1. A process for the removal of moisture and oils from plant material by physical agitation in a low temperature, preferably ambient air stream comprising the steps of:

(i) causing relatively moist plant material to flow across a high velocity air stream while being maintained as a rotating band within the air stream;

(ii) retaining the plant material in the said band to comminute the plant material and to cause physical separation of liquids from the plant material as an aerosol;

(iii) progressively removing air, the aerosol and relatively dry comminuted material entrained in the air from the band of plant material;

(iv) separating the air stream and aerosols from the comminuted plant material entrained therein;

(v) and collecting the relatively dry comminuted material.

2. A process according to claim 1 including the further step of subjecting the relatively dry comminuted material to evaporative drying at a higher temperature in an evaporative dryer.

3. A process according to claim 1 wherein the aerosolizer includes fluidised bed interrupter and the process employs the further step of selectively adjusting the interrupter to present material residence time in the aerosolizer.

4. An apparatus for low temperature drying of plant material, the apparatus comprising a flow dryer having an inlet duct in series with aerosolizer followed by an outlet duct, the said aerosolizer having a chamber including an aerosolizer inlet communicating with the inlet duct and an aerosolizer outlet communicating with the outlet duct in order for a stream of low temperature gas to flow through the aerosolizer chamber, a plurality of aerosolizing blades mounted for rotation in the aerosolizer chamber so that particles of matter circulate in the aerosolizer chamber as a band by reason of the rotation of the blades, the rotation of the blades and the high velocity air stream through the chamber causing separation of unbound liquids as an aerosol entrained in the air stream which leaves the chamber through the outlet.

5. The apparatus according to claim 4 wherein the aerosolizer is utilised as part of a pre-dryer assembly whereby after exiting the aerosolizer the partially dried comminuted material is then fed into a thermodynamic flow dryer where it is further dried under evaporative drying.

6. An apparatus according to claim 4 wherein the aerosolizer includes a fluidised bed interrupter to interrupt normal flow of material through the aerosolizer.

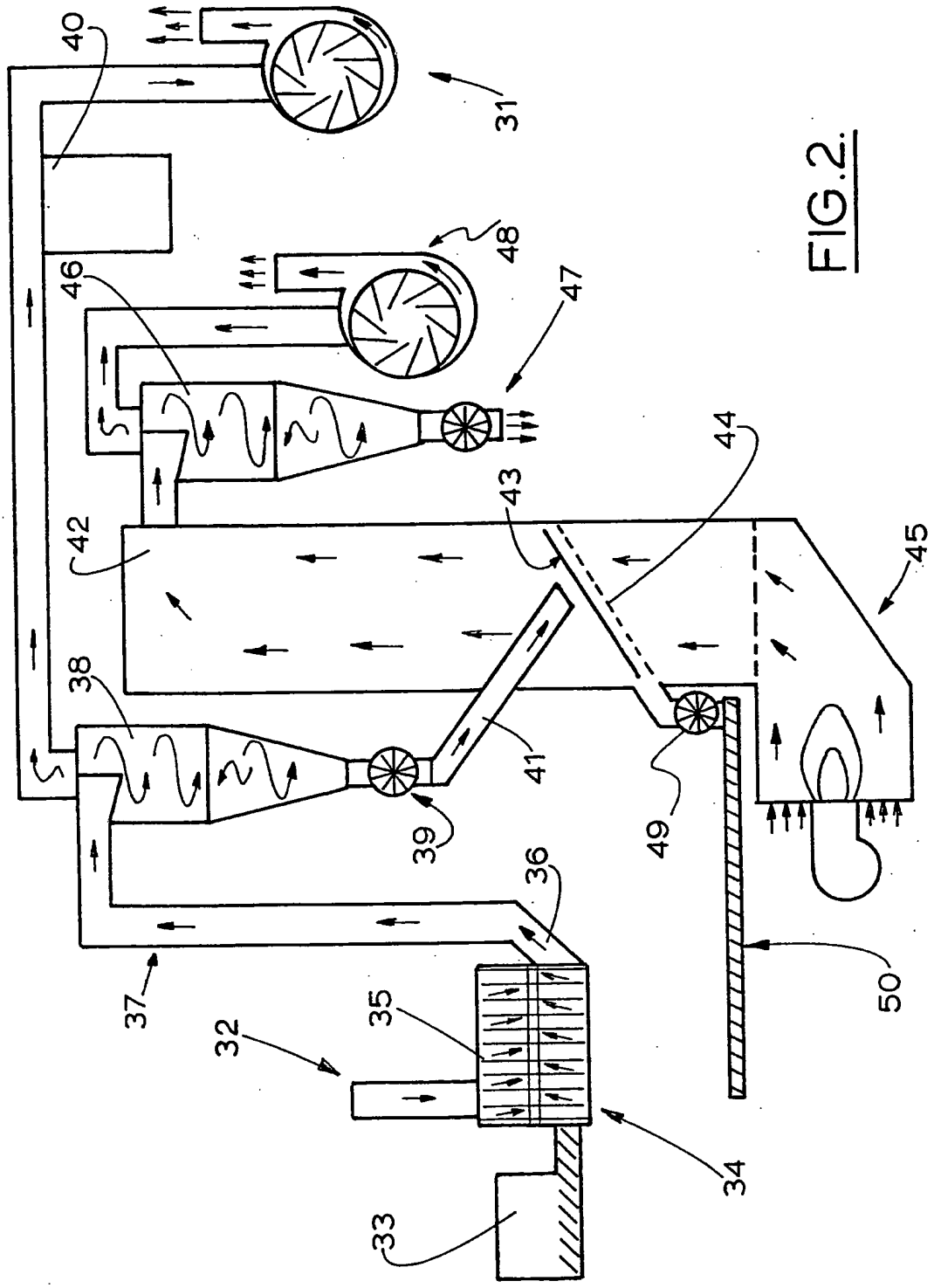

FIG.2.

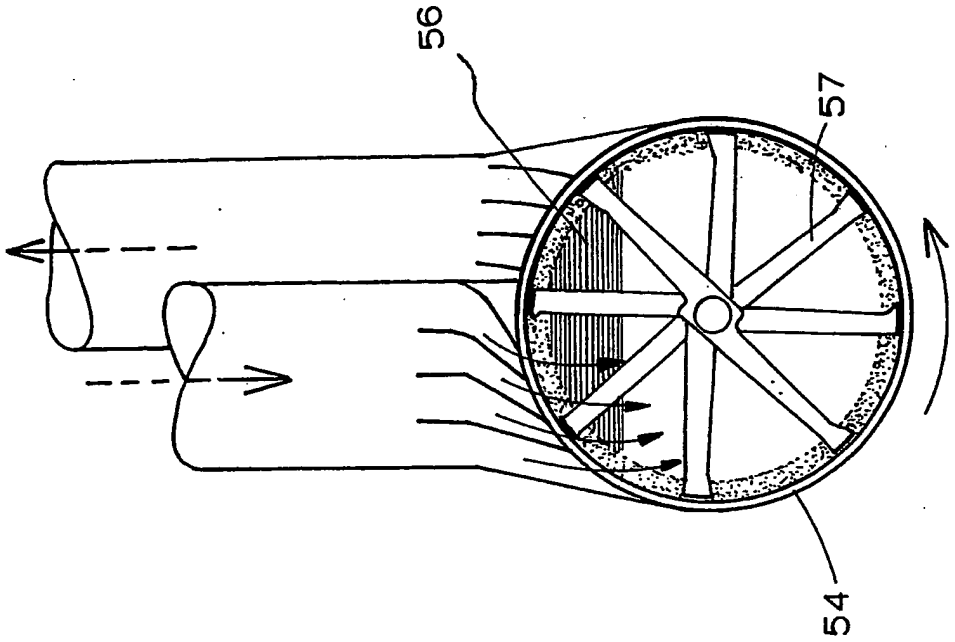

FIG.4.

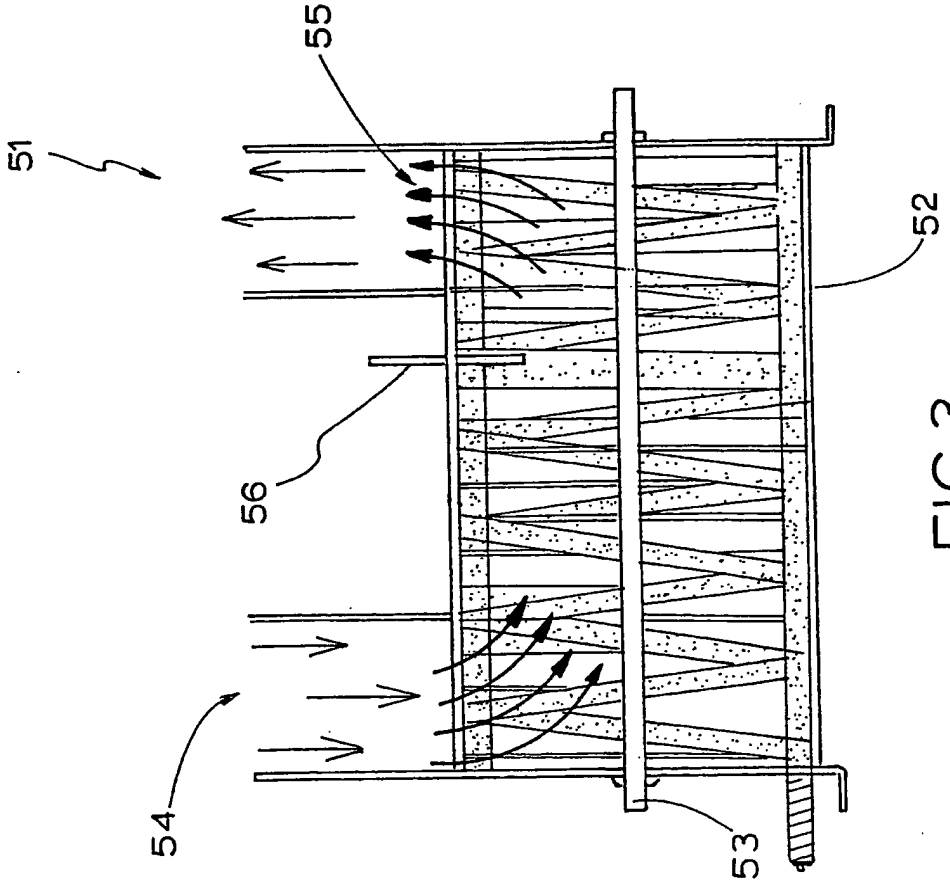

FIG.3.

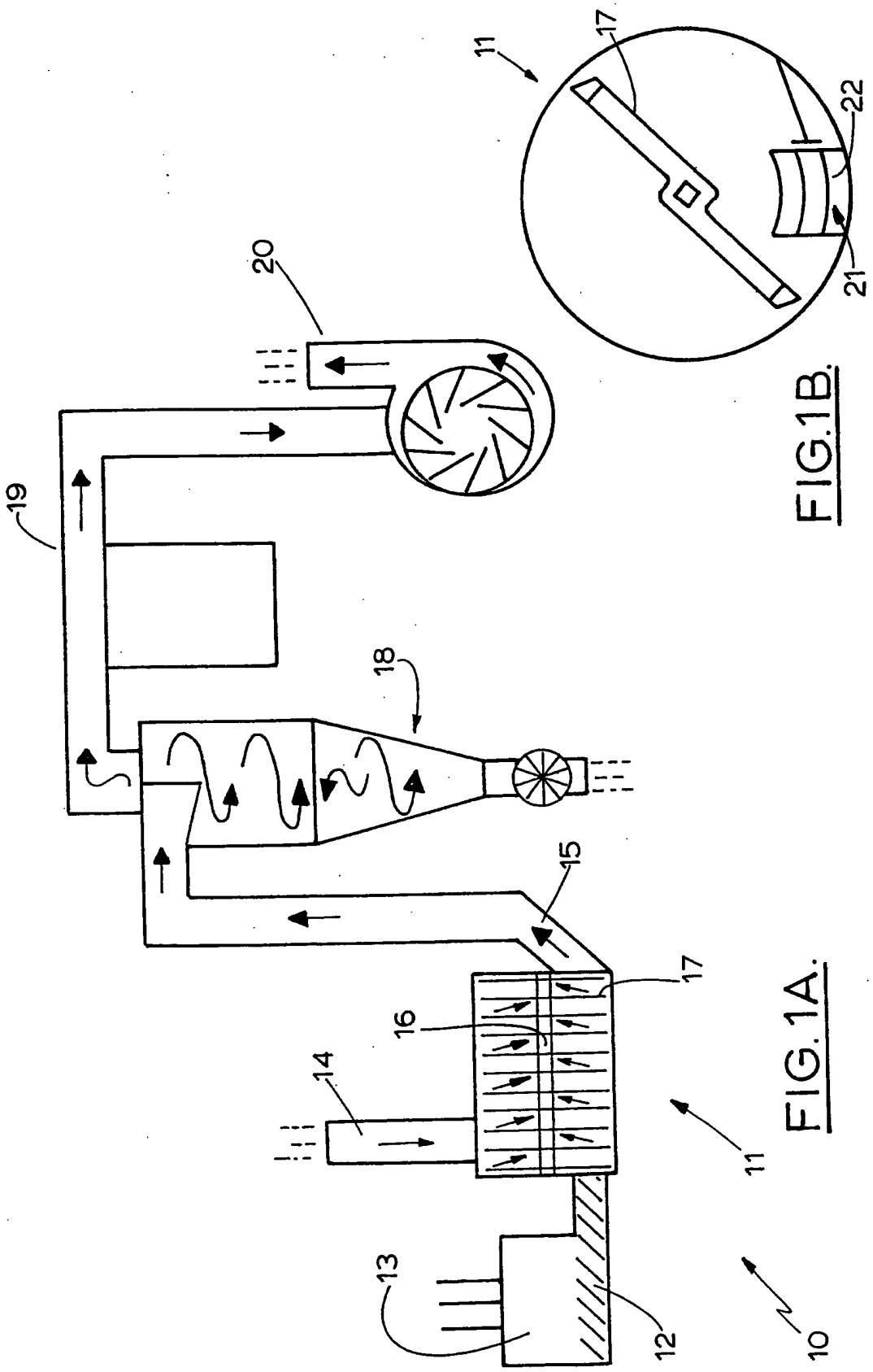

FIG.1A.

FIG.1B.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU 99/00530

A. CLASSIFICATION OF SUBJECT MATTER

Int Cl[6]: A23N 12/08; A23L 3/40

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A23N 12/08; A23L 3/40; F26B 3/10, 17/10

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Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 92/12796 (TECHDANIA) 6 August 1992 Entire document	1-6
A	WO 95/12795 (DELOIT TECHNOLOGIES) 11 May 1995 Entire document	1-6
A	WO 90/05026 (AKT CONSULTANTS) 17 May 1990 Entire document	1-6

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International application No.
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WO 92/12796	AU 12022/92	DK 98/91	EP 567560		
WO 95/12795	AU 80854/94	AU 689155	BR 9407931	CA 2175385	EP 727032
	FI 961850	US 5454176			
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